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Research Article

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Constraints to cabbage (*Brassica oleracea* var. *capitata* L.) production in peri-urban area of Saharsa district in Bihar

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Summary

Vegetables are the integral part of the balanced diet of human since time immemorial. Globally, the role of vegetables has been recognized in solving the problem of food and nutritional security. A survey conducted to assemble baseline information on farming practices to cabbage production in peri-urban area of Saharsa district.Structured questionnaires used to elicit information from cabbage farmers, where cabbage is intensively produced. The level of education among the growers was low as only 6.67 per cent had secondary education. Majority of the growers (68%) did not own the lands, thus, resulting in approximately 65 per cent of them cultivating less than one acre of cabbage. Majority of cabbage farmers (61.67 %) planted cabbage on raised beds. Cabbage production was characterized by high use of inorganic fertilizer (NPK). Seventy-three per cent farmers employed the watering cans in cabbage production. Farmers in their quest to mitigate the high insect pest infestation and problems such as wilting of plants, leaf curl and leaf spots resorted to high frequency of pesticides application. The information gathered from this study would form the basis for the formulation of an integrated pest management (IPM) as well as integrated nutrient management (INM) strategy to enhance environmentally sustainable production of cabbages. This would reduce environmental degradation and ensure maximum protection for human well being.

Key words : Constraints, Cabbage, pests, IPM

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Introduction

Vegetables are an important component of a healthy diet in the world (Obuobie *et al.*, 2006). Vegetables have been hailed for their nutritional and non-nutrient bioactive ingredients (Smith and Eyzaguirre, 2007). If consumed daily in sufficient amounts, they would help to prevent major diseases such as cardio-vascular diseases and certain cancers. The low intake of fruit and vegetables is responsible for about 31 per cent of is chaemic heart diseases and 11 per cent of strokes (WHO, 2002). Each year, over 2.7 million lives would be saved if fruit and vegetables consumption are sufficiently increased. It has been recommended that a minimum of 400 g of fruit and vegetables should be consumed/day/individual (FAO/ WHO, 2003).

Cabbage (*Brassica oleracea* var. *capitata* L.) is a popular vegetable grown by peri-urban dwellers in

Saharsa district of Bihar. However, the production of cabbage is confronted with numerous constraints. These include high cost of inputs such as pesticides and fertilizers and attack by pests and diseases. Caterpillars of the Diamond back moth (*Plutella xylostella*), the cabbage web worm (*Hellula undalis*) and cabbage aphids (*Brevicoryne brassicae*) are the most serious pests of cabbage in this region causing percentage leaf damage between 18 and 31 per cent. Pest infestation normally leads to reduction in market value. Plant parasitic nematodes have also been implicated to constraint cabbage production (Waceke, 2007). Farmers have been applying various synthetic pesticides to reduce damage caused by these pests. These pesticides have been reported to cause toxicological and environmental problems as well as the development of resistant strains

Table A : Villages name

Sr. No.	Block name	Villages name
1.	Banma itahri	Ghordaur, Sugma, Rasalpur, Sahuriya
2.	Kahra	Tiwaritola, Rahua, Rahuamani, Bariyahi
3.	Mahishi	Rajanpur, Mahpura, Mauna, Mahpura, Telhar
4.	Nauhatta	Walva, Chandrayan-ekar, Nauhattagaon, Muradpur
5.	Patarghat	Chinahi jamhra, Bisanpur, Pahaarpur, Pama
6.	Salkhua	Tengraha, Utesara, Bahorwa, Mubarakpur
7.	Sattar katiya	Rohua, Gobergarha, Panchgachhiya, Tuniahi
8.	Saur bazar	Padampura, Silet, Gamhariya, Sapaha
9.	Simri bakhtiyarpur	Hussainchak, Khamauti, Sitanabaad, Turki
10.	Sonbarsa	Sahpur, Manguwar, Barsam, Sarauni

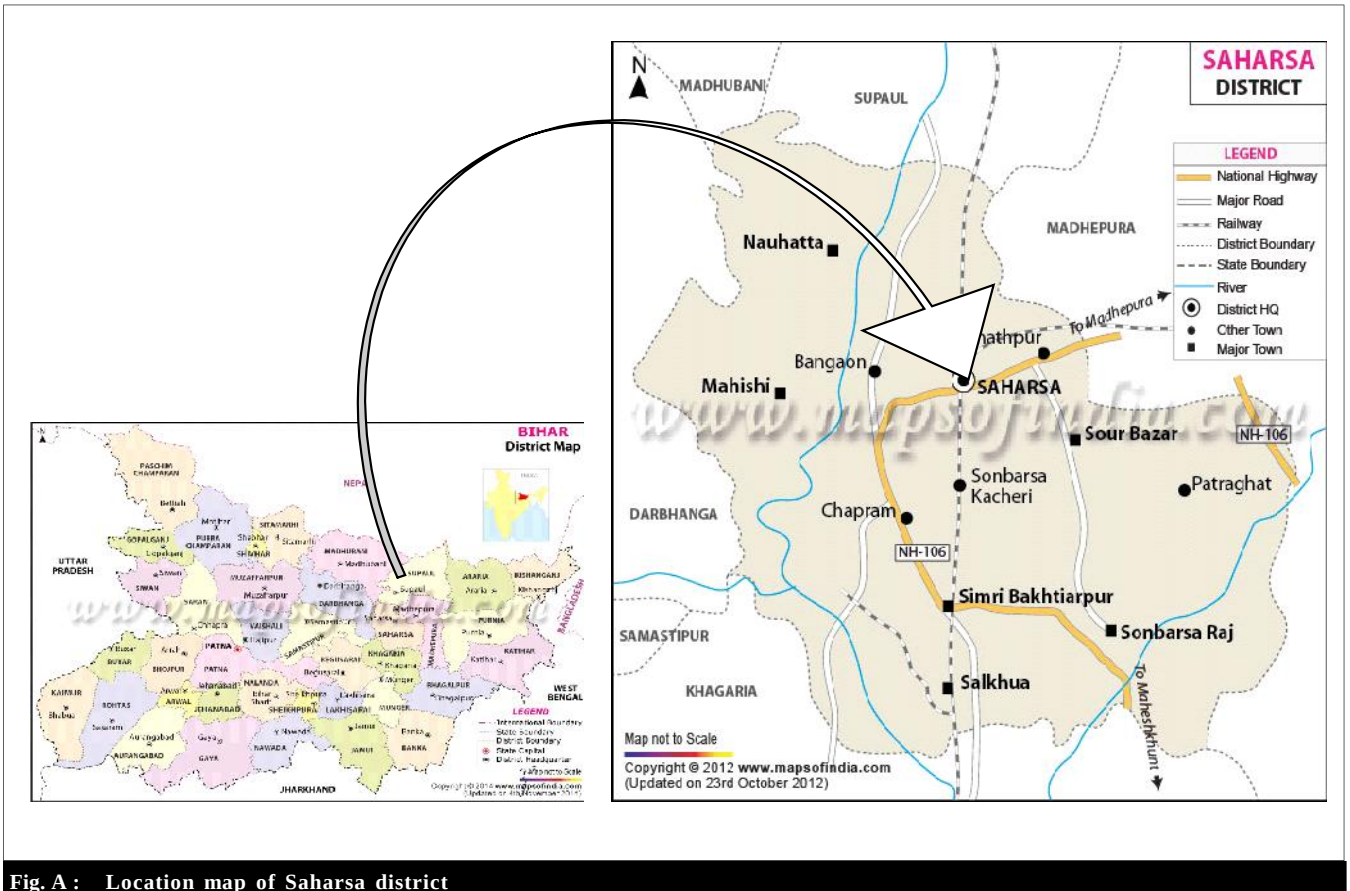

Fig. A : Location map of Saharsa district

of pests (Ninsin, 1997). The improper use of pesticides is an issue of much concern. It has been estimated by the world health organization (WHO) that about 20,000 people die each year from pesticide poisoning and at least 3 million people suffer acute health effects (Barbara, 1993). Pesticide residue in food items have been a concern to consumer groups. Most pesticides especially, organo-chlorines are resistant to microbial degradation. They can, therefore, accumulate in human body fats and the environment posing problems to human health (Ejobi *et al.*, 1996). Pesticides are considered to be indispensable for the control of pests and diseases and hence the production of adequate food supply for an increasing population. However, some of them contain dangerous constituents known to be endocrine disrupting compounds (Kluive, 1981). Over the decades there have been growing issues of concerns related to health, environmental quality and food safety. There is a general belief that diets with greater proportions of vegetables and fruits can prevent or delay a number of life threatening diseases. Unfortunately, the consumption of cabbage is being discouraged by the public due to possible health risk associated with pesticide residues. The need to explore more options under non-pesticide management of crops is becoming popular among vegetable growers, since they endeavour to keep the management of pests and cost of cultivation to a minimum. This study was aimed at investigating farmers' practices and constraints to cabbage production to assist in formulating integrated pest management (IPM) strategies and the unsafe use of agro-chemicals in three selected communities of ten blocks of Saharsa districts in Bihar. The four villages from each block were selected thus total forty villages were selected which is given in Table A and Fig. A.

Resource and Research Methods

The questionnaires were designed to collect information from cabbage farmers in Saharsa district on production practices and constraints. The Saharsa district lies between 25.88° N latitude and 86.6° E longitude. The total geographical area is 1661.30 sq. km. the climate of the district is warm humid with rain fall of 1450 mm which is suitable for good cultivation of vegetables. Visits were made to all block of Saharsa, by the several scientists of different discipline like, soil scientist, Economist, Agronomist and plant pathologist in the major cabbage growing area of Saharsa. The farmers were contacted to identify the important communities that produce cabbage. Three cabbage producing communities (*viz.*, Mushhar, Dhangar and Pasi) were selected. Twenty farmers were randomly sampled from each community and the questionnaires were administered accordingly. Basically, the questionnaires dealt with the demographic characteristics of respondents, cabbage production systems in the study areas, varieties grown, sources of seeds, pests and diseases encountered, pesticides usage and other management practices.

Research Findings and Discussion

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Demographic and sociological characteristics :

The demographic characteristics of the respondents are presented in Table 1. A total of 60 farmers were involved in the study. Out of this, 43 farmers representing approximately 71.67 per cent were males whilst 17 farmers (28.33%) were females. The educational levels of respondents were low. Twenty per cent had no formal education with 30 per cent having primary education, 43.33 per cent have middle and 6.67 per cent have secondary education. The low level of education amongst respondents probably explains the indiscriminate use of pesticides by farmers due to unawareness of chemicals effect on humans and environment. Extremely low level of education has been reported to affect the level of

Table 1 : Demographic and sociological characteristics of farmers in the study area

Variables	Frequency	Percentage
Sex		
Male	43	71.67
Female	17	28.33
Total	60	100.00
Level of educational		
No formal education	12	20.0
Primary	18	30.0
Middle	26	43.33
Secondary	4	6.67
Total	60	100.00
Farming experience		
3-5 years	37	61.67
5-10 years	23	38.33
Total	60	100.00

technology adoption and skills acquisition amongst farmers (Oyekale and Idjesa, 2009). Approximately 61.67 per cent had been farming from 3 to 5 years, while 38.33 per cent have been cultivating cabbage from last 5 to 10 years.

Farm characteristics :

The farm characteristics of cabbage grower are presented in Table 2. Size of holdings, land ownership and number of times cabbage is cultivated in a year are given prominence. Generally, farmers covered in the survey are small scale farmers. Only 6 farmers representing 10 per cent had more than two (2) acres of cabbage crop. The 65 per cent had less than one acre of crop. The small farm sizes could be the result of the fact that approximately 68 per cent did not own the land they used for cabbage cultivation. Majority of respondents, about 88 per cent cropped cabbage twice a year, while 11.6 per cent cultivate once within a year. Factors such as availability of water, income, market demand and low pest pressure influenced the annual frequency of cultivation.

Varieties and source of seeds :

It became evident from the survey that two improved varieties of cabbage, green globe and M.H.C.B.600 were cultivated by farmers. Green globe was the most preferred variety with 88 per cent of respondents cultivating it (Fig. 1). The preference of green globe over MHCB 600 was based on better performance, particularly desirable head size of the variety. Improved varieties can potentially strengthen farmers' cropping systems by increasing yields, improving drought resilience, boosting resistance to pests and diseases and also by capturing new market opportunities

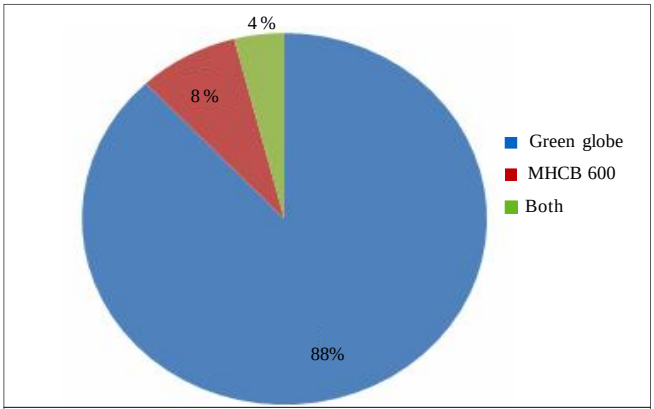

Fig. 1 : Improved varieties of cabbage cultivated by farmers of Koshi Zone-II

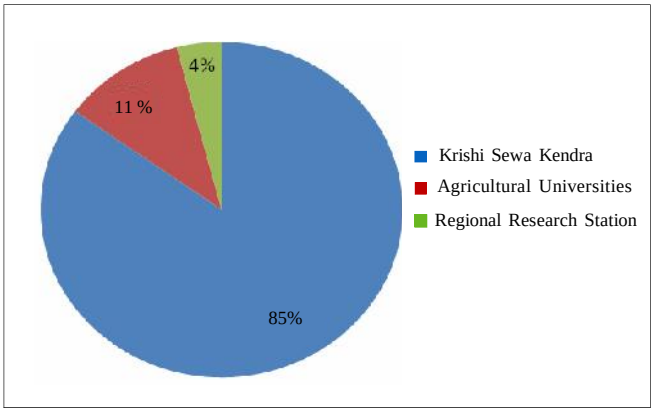

Fig. 2 : Different sources of seed from where farmers obtained their seeds

Table 2 : Different farm characteristics of Saharsa district of Bihar

Variables	Frequency	Percentage
Farm size		
Less than 1 acre	39	65.0
1-2 acres	15	25.0
More than 2 acres	6	10
Total	60	100.00
Land ownership		
Yes	19	31.67
No	41	68.33
Total	60	100.00
Frequency of cabbage cultivation		
Once a year	7	11.67
Twice a year	53	88.33
Total	60	100.00

(Quezada *et al.,* 2011). Significantly large number, 85 per cent of the farmers obtained their seed supplies from credible sources like Krishi Sewa Kendra (Agro input dealers), 11 per cent from near by Agricultural Universities (*viz.,* Bihar Agricultural University and Rajendra Agricultural University) and 4 per cent Regional Research Station (Fig. 2). Obtaining improved seed from credible source is an incentive for increased production.

Seed bed preparation methods :

Three seed bed preparation methods were employed by the farmers. The three methods were; planting on the flat, on raised beds and on ridges. Majority of farmers, approximately 62 per cent planted cabbage on raised beds whilst 18 per cent planted on ridges with the remaining 20 per cent planting on the flat. Seed bed preparation is an important factor influencing crop production. Cabbage grown on raised bed is known to perform better than on the flat because of enhanced water and nutrients utilization by the plants on the former than on the latter seed bed preparation method.

Nursery practices :

Major nursery operations as methods of soil sterilization, sowing seed on the nursery bed, post-emergence practices and period of stay of seedlings on nursery beds differed among them (Table 3). Sterilization was done to control soil nematodes and other pathogenic organisms and weed seeds on the nursery bed. The most popular soil sterilization method of burning slashed weeds before seed bed preparation was employed by 45 per cent respondents while digging up soil and exposing to the sun (15 %) was the least employed. Sixty-five per cent broadcast the seeds for sowing at the nursery whereas dibbling (35%) was least preferred. Significant post emergence operations were; raising of sheds over seedlings to protect seedlings from direct sun (38.33%), hand picking of weeds (35%), covering of seedlings with net to prevent insect damage (5%), thinning out of seedling to prevent etiolation (3.33%) and applying

Table 3 : Nursery practices adopted by farmers of Saharsa district

Variables	Frequency	Percentage
Seed bed preparation methods		
On the flat	12	20
On raised beds	37	61.67
On ridges	11	18.33
Soil sterilization method		
Dig up soil and expose to sun	9	15.0
Burning slashed weeds	27	45.0
Dig up soil, watering and cover with layer of mulch	16	26.67
No treatment before sowing seed	8	13.33
Propagation method in the nursery		
Broadcasting	39	65
Dibbling	21	35
Post-emergence practices in the nursery		
Raise shed over seedlings	23	38.33
Hand picking of weeds	21	35
Cover bed with net for pests control	3	5
Thinning out of seedlings	2	3.33
Application of pesticides	8	13.33
All the above	3	5
Duration of seedling in the nursery		
Three weeks	29	48.33
Four weeks	27	45
Five weeks	4	6.67
Total	60	100.00

pesticides to protect seedlings from pest damage (13.33%). Farmers transplanted seedlings at different stages of growth; 48.33 per cent transplanted at 3 weeks of age, 45 per cent at 4 weeks and 6.67 per cent at 5 weeks. Staggering planting times, has the benefit of cabbage availability in the markets for longer duration.

Fertilizer usage, type and frequency of fertilizer application :

Table 4 provides an idea about the use, type and frequency of fertilizer application in cabbage production. In vegetable production, fertilizer frequencies are used by the farmers with the intention of enhancing production potential. Majority of farmers, 95 per cent used fertilizer to boost cabbage production. Inorganic fertilizer was used by about 53 per cent of the farmers while a meager 8.33 per cent used organic sources of fertilizer. Frequency of fertilizer application was based on farmers' knowledge about the importance of the input to crop being cultivated and also on the financial strength of individuals. As such 53.35 per cent apply fertilizer two times and 13 per cent apply once before harvesting. The majority of farmers who apply fertilizer two times stand a better chance of increasing their production levels compared with those who apply fertilizer once. While few farmers had applied fertilizer more than twice, their response is comparatively less because of short duration of crop.

Water requirements for cabbage production :

Table 5 presents the watering regime as practiced

Table 4 : Fertilizer usage, type and frequency of fertilizer application adopted by farmers

Variables	Frequency	Percentage
Fertilizer application		
Yes	57	95
No	3	5.0
Type of fertilizer used		
Organic	5	8.33
Inorganic	32	53.33
Both	23	38.33
Frequency of fertilizer application		
Once	8	13.33
Twice	32	53.35
More than twice	20	33.33
Total	60	100.00

Table 5: Irrigation systems and frequency of application adopted by farmers

Variables	Frequency	Percentage
Watering during growth phase		
Yes	51	85
No	9	15
Type of irrigation system		
Watering cans	44	73.33
Furrow	12	20.0
Other	4	6.67
Watering frequency during dry season		
Once daily	24	40.0
Twice daily	16	26.67
Thrice daily	6	10.0
Once weekly	5	8.33
Thrice weekly	9	15
Total	60	100.00

by farmers and the type of irrigation system employed. Different watering regimes were encountered. Cabbage production requires water management particularly in the dry season. Shortage of water leads to drought with obvious agricultural and societal impacts (Morrison *et al.*, 2007). Inability to supply sufficient water during the dry season would result in total crop failure. This spanned from once daily in the dry season to thrice weekly. Farmers employed inefficient irrigation system; the use of watering cans in cabbage production. The use of watering cans to supply the water needs of cabbage crop was more popular (73.33%) relative to the use of furrow irrigation (20%). Sprinkler irrigation is more efficient watering regime than watering cans. However, lack of

Table 6 : Weed management on cabbage farms adopted by the farmers

Variables	Frequency	Percentage
Weed control method employed		
Handpicking	17	28.33
Hoeing/ use of hand fork	37	61.66
Application of chemicals	6	10.0
Weed control frequency		
Once	4	6.66
Twice	18	30.0
Thrice	19	31.66
Four times	8	13.33
More than four times	11	18.33
Total	60	100.00

Table 7 : Common pests found in nurseries and cabbage fields and their management

Variables	Frequency	Percentage
Insect pests		
Hellicoverpa armigera	17	28.33
Plutella xylostella (Hirakprist insect)	10	16.67
Brevicoryne brassicae (Mahu)	13	21.67
Spodoptera litura	8	13.33
White flies	11	18.33
Sucking bugs	1	1.67
Insect management		
Hand picking and destruction	2	3.33
Pesticides application	55	91.67
Rotation of crops	2	3.33
Intercropping with repellent crops	1	1.67
Pesticides used		
Attack	38	63.33
Combat	12	20.0
Ridomil	6	10.0
Neem seed extract	4	6.67
Frequency of application		
Twice	4	6.67
Thrice	5	8.33
Four times	12	20.0
More than four times	39	65.0
Total	60	100.00

adequate finances has compared majority of the farmers to use watering cans resulting in lower production.

Weed management on cabbage farms :

Various weed species were encountered in cabbage field but the most prominent were: Elephant grass (*Pennisetum purpureum*), butterfly pea (*Centrosema pubescens)* and common purslane (*Portulaca* spp). Noxious weeds infestation has been reported to reduce yield of crops (Awodoyin *et al.*, 2007) and effective management of weeds is pre-requisite to minimize interference as well as other pest infestation through the weeds for higher yields. Three methods of weed management were employed; hand picking, use of garden tools (as hoes, hand fork) and application of herbicides (Table 6). As many as 61.67 per cent used garden tools to manage weed growth whilst as low as 10 per cent used herbicides. Depending on cropping history of the land used for cabbage production, more than thrice weeding could be done before harvest. The highest frequency of weeding (31.67 %) was thrice before harvesting of crop. Farmers took weed management seriously which was insurance for higher yields.

Pest pressure and management :

Table 7 indicates insect pests associated with cabbage production at the nursery and on the field. Insect pests could be managed tactfully otherwise result in total

Table 8 : Farmers' awareness regarding nematodes problems

Variables	Frequency	Percentage
Awareness of pest		
Yes	13	21.67
No	47	78.33
Nematode control		
Use of synthetic nematicides	8	13.33
Roughing of infected plants	4	6.67
No control	41	68.33
Use of neem extracts	7	11.67
Total	60	100.00

Table 9 : Diseases of cabbage and their management

Variables	Frequency	Percentage
Incidence of diseases on farms		
Yes	53	88.33
No	7	11.67
Prevalent diseases		
Wilting of plants	25	41.67
Leaf curl	21	35
Leaf spot	14	23.33
Diseases management		
Rouging of infected plants	14	23.33
Application of fungicides	35	58.33
Rotation of crops	11	18.33
Adverse effects of synthetic chemicals		
Running stomach	22	36.67
Itching eyes	14	23.33
Running nose	14	23.33
Skin rushes	6	10
Dizziness	4	6.67
Total	60	100.00

crop failure. A number of insect pests attract on cabbage plants at different stages of the plant growth due to their nutritive and luxuriant nature. The prominent amongst them were: *Hellicoverpa armigera, Plutella xylostella, Brevicoryne brassicae* and *Spodoptera litura*. Pesticide application was the most popular insect management strategy with attack and combat as the most effective products. Majority of the farmers (65%) applied pesticides more than four times before harvesting of crop.

Awareness of nematode problems on cabbage fields:

Nematode infestation result in stunting of growth, yellowing of foliage, galling of the root system and disruption of the nutrient absorption capacity of plants leading to reduction of yield (Luc *et al.,* 2005). Approximately 78 per cent of the farmers don't know about nematodes. However, only 13 per cent of them have little bit idea of nematode and they tried to controlled nematodes on their farms with pesticides. Approximately 12 per cent of farmers who managed nematodes used bio-pesticides in the form of neem (*Azadirachta indica*) seed extracts while the remaining 13.33 per cent used synthetic nematicides. Approximately 68 per cent of the farmers did not control nematodes on their farms since they don't have idea about this pest. The root lesion nematode, *Pratylenchus penetrans* for instance has the potential to reduce market yield of cabbage by 19-33 per cent (Olthof and Potter, 1973). In view of the devastating effect of nematodes on cabbage, general awareness of this pest is essential to facilitate sustainable management strategies (Table 8).

Diseases of cabbage and their management :

As many as 88 per cent of the farmers complained bitterly about the devastating effects of diseases on cabbage. Farmers identified wilting of plants, curling of leaves and leaf spots as major pathological problems. Rouging of affected plants, application of fungicides and rotation of crops were the major means of managing cabbage diseases (Table 9).

Conclusion :

To ensure healthy and high productivity of cabbage, farmers have to abuse the use of pesticides and fertilizers which have serious environmental impact. The disadvantages of improper use of synthetic products completely outweigh. The information gathered from this baseline study, form the basis for the formulation and implementation of IPM and INM module to enhance environmentally safe and sustainable production of cabbages. These practices reduce environmental degradation and ensure maximum protection for humans well being.

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